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FLOOD INSURANCE STUDY

LOGAN COUNTY, COLORADO
UNINCORPORATED AREAS

SEPTEMBER 29, 1989

Federal Emergency Management Agency

COMMUNITY NUMBER 080110

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY
LOGAN COUNTY, COLORADO (UNINCORPORATED AREAS)

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the unincorporated areas of Logan County, Colorado, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for the South Platte River and Pawnee Creek used for this study were performed by the U.S. Army Corps of Engineers (COE), Omaha District, as reported in Special Flood Hazard Information Report, South Platte River, Volume III (Reference 1), and Floodplain Information, South Platte River and Pawnee Creek, Sterling, Colorado (Reference 2). The hydrologic and hydraulic analyses for Sand Creek and the Pawnee Creek Overflow used for this study were performed by Charles F. Leaf, P.E., and Resource Consultants, Inc., as reported in Summary Report, Floodplain Information, Sand Creek and the Pawnee Creek Overflow at Sterling, Colorado (Reference 3).

1.3 Coordination

In August 1987, the Federal Emergency Management Agency (FEMA) directed its Technical Evaluation Contractor to prepare a Flood Insurance Study for Logan County using information published in floodplain information reports prepared by the COE, Omaha District, Charles F. Leaf, P.E.; and Resource Consultants, Inc. (References 1, 2, and 3).

On September 14, 1988, the results of this study were reviewed at a final coordination meeting attended by representatives of the community and FEMA. All significant problems raised at that meeting have been resolved in this study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Logan County. The area of study is shown on the Vicinity Map (Figure 1).

The City of Sterling and the Towns of Crook, Fleming, Merino, Peetz, and Iliff are not included in this study.

The following flooding sources were studied by detailed methods throughout the county:

South Platte River, from a point approximately 7,020 feet downstream of the Burlington Northern Railroad to a point approximately 12,440 feet upstream of U.S. Highway 6 (a reach of approximately 4.8 miles)

Pawnee Creek Overflow, from its intersection with Sterling Irrigation Ditch No. 1 to its confluence with Sand Creek (a reach of approximately 0.3 mile)

Sand Creek, from its mouth to a point approximately 3,140 feet upstream of Haul Road (a reach of approximately 4.5 miles)

The areas studied by detailed methods were selected based on the extent and validity of available existing hydrologic and hydraulic data.

The South Platte River was studied by approximate methods from the Washington County line to a point approximately 7,020 feet downstream of the Burlington Northern Railroad and from a point approximately 12,440 feet upstream of U.S. Highway 6 to the Sedgwick County line.

Approximate methods of analysis were used to study all the remaining areas having a potential flood hazard that did not have available detailed scientific data.

2.2 Community Description

Logan County is located in northeastern Colorado, and is bounded to the north by Nebraska; to the south by Morgan, Washington, and Yuma Counties, Colorado; to the east by Sedgwick and Phillips Counties, Colorado; and to the west by Weld County, Colorado. According to the 1980 U.S. Census, Logan County had a population

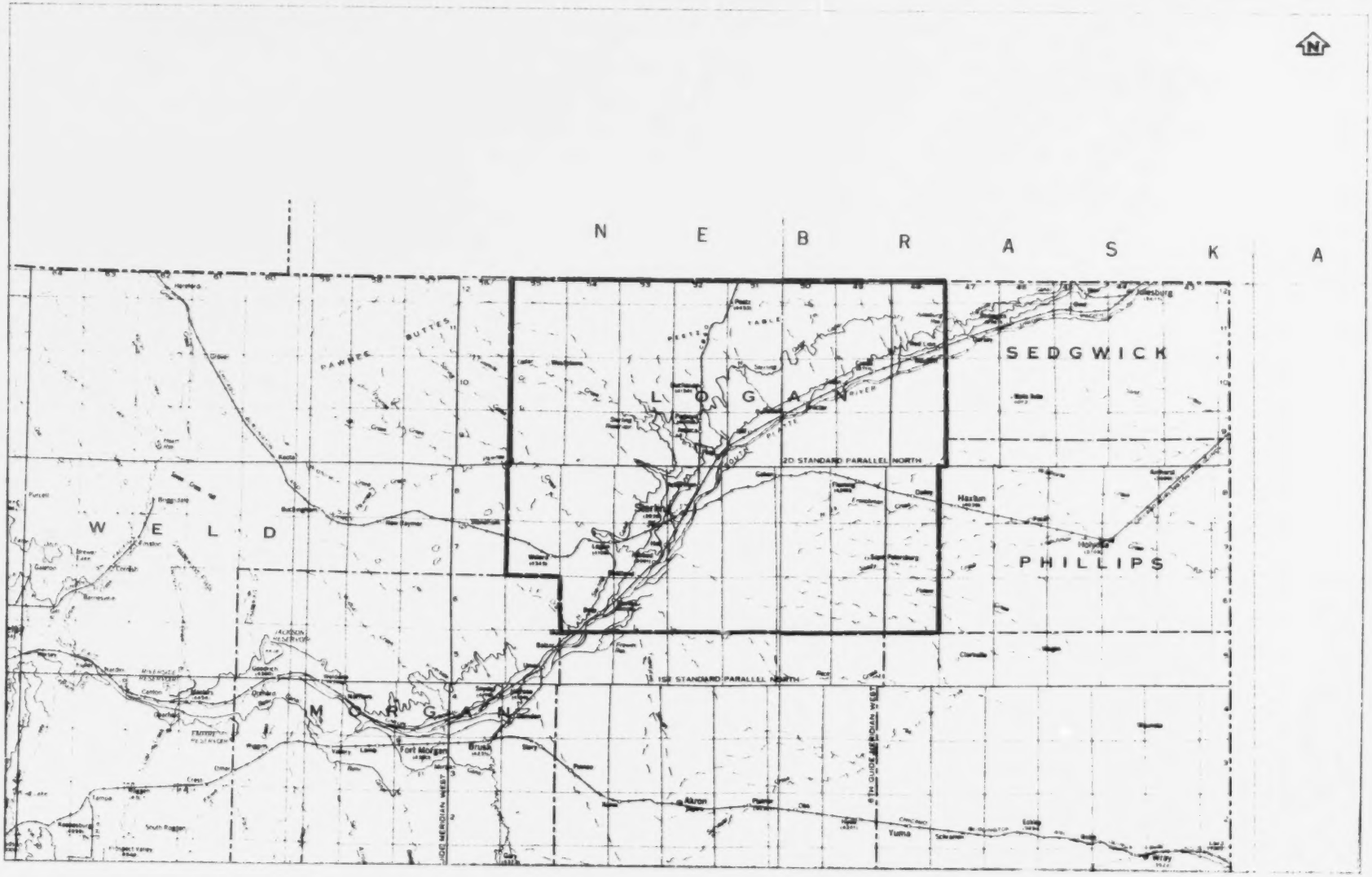


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOGAN COUNTY, CO
(UNINCORPORATED AREAS)

APPROXIMATE SCALE

16 0 16 32 48 MILES

VICINITY MAP

of 19,800 in 1980 and 18,852 in 1970, an increase of 5 percent (Reference 4). The climate of Logan County is primarily affected by a northwest wind. It has an average annual precipitation of 19 inches, not including an average annual snowfall of 30.4 inches. The mean annual temperature is 48.6°F. The coldest month is January, with a mean temperature of 38.8°F, and the warmest month is July, with an average temperature of 89.9°F. The average annual number of clear days is 299.

The total land area for Logan County is 1,849 square miles and is mostly comprised of high rolling plains. The land is used primarily for the production of livestock grains, hay, and oil products.

2.3 Principal Flood Problems

Two crossings obstruct floodflows along the South Platte River in Logan County. These are the Burlington Northern Railroad and U.S. Highway 6 bridges.

The Pawnee Creek Overflow is created by the U.S. Highway 6 and the combined Union Pacific Railroad and the Burlington Northern Railroad bridges crossing Pawnee Creek. During periods of high stage on Pawnee Creek, floodwaters can escape the Pawnee Creek valley to flow over land near Riverside Cemetery toward the City of Sterling due to the constrictive crossings.

Flooding along the South Platte River and Pawnee Creek Overflow in the Sterling area normally occurs from March through September, with the most frequent flooding occurring during June. Annual peak discharges, however, have been recorded throughout the year. Floods in the Sterling area normally occur under nonice-affected conditions. Although their historical frequency of occurrence is rare, ice jams are possible on the South Platte River. Irrigation works also influence flooding in the Sterling area by diverting floodwaters, by levee failure, or by combinations of both.

Floodwaters on the South Platte River and Pawnee Creek in the vicinity of Sterling can result from intense localized rainfall or general rains, either of which may be augmented by snowmelt. The intense rainstorm floods result from intense rainfall over areas of relatively small areal extent. These storms can produce extremely rapid concentrations of floodwaters and rapid rises in stream levels. Because of little warning time prior to streams attaining flood stages, this type of storm can produce floods that are extremely hazardous. This type of flood produces high peak discharges on tributaries in the general vicinity of the rainstorm. However, the discharges attenuate rapidly on the South Platte River downstream from the contributing tributaries due to valley storage of the floodwater.

Erosive effects can be considerable in the event of any flood regardless of its origin. Floods resulting from intense

rainstorms typically create severe erosion damages in a short period of time due to the relatively large peak discharge and high velocity of the floodwater. Erosion damages from snowmelt or general rainstorm floods usually result from prolonged exposure to the floodwater because of the long duration typical of these floods.

2.4 Flood Protection Measures

Three reservoirs in the South Platte River Basin located upstream of Sterling were built primarily for flood control. These reservoirs, Cherry Creek and Chatfield Dam, both near Denver, Colorado, and Bear Creek near Morrison, Colorado, have drainage areas of 385, 3,020, and 260 square miles, respectively. No other flood protection measures are located within Logan County.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community.

Discharge magnitudes for floods on the South Platte River were based on data collected at U.S. Geological Survey stream gaging stations located at Denver, Henderson, Kersey, Weldona, Balzac, and Julesburg, Colorado. Discharge values developed at Sterling were part of an overall South Platte River study (Reference 1). Peak discharge-probability relationships were developed from these records. A basin model was developed to determine discharge probability relationships for locations other than those at the stream gaging station locations.

Discharge magnitudes for Pawnee Creek Overflow floods were developed using the Massachusetts Institute of Technology Catchment Model (MITCAT). The Pawnee Creek basin was divided into 60 subbasins. Rainfall data utilized were derived from U.S. Weather Bureau Technical Paper No. 40 (Reference 5). Maximum 3-hour rainfall values used for the 10-, 50-, 100-, and 500-year floods are 1.65, 2.28, 2.60, and 3.32 inches, respectively. An infiltration rate of 0.60 inch per hour was used. The standard deviation estimated for Pawnee Creek by the MITCAT model compared favorably with that determined in an adjacent basin having stream gage data. It should be assumed that a Sand Creek flood will peak within approximately 4 hours from the onset of heavy rainfall. This compares with a lag time of approximately 15 hours for a Pawnee Creek Overflow flood to peak at Sterling.

Peak discharge-drainage area relationships for the South Platte River, Pawnee Creek Overflow, and Sand Creek are shown in Table 1.

TABLE 1. Summary of Discharges

Flooding Source And Location	Drainage Area (Square Miles)	Peak Discharge(cfs) 10-Year	50-Year	100-Year	500-Year
South Platte River At Crook	19,238	17,000	46,500	68,000	152,000
Pawnee Creek Overflow At Mouth	40	1,250	2,400	5,000	11,000
Sand Creek At State Highway 138	40.5	1,250	5,250	6,880	15,000

3.2 Hydraulic Analysis

Analyses of the hydraulic characteristics of flooding from the riverine sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sectional data and topographic mapping prepared at a scale of 1:2,400, with a contour interval of 2 feet, were established by photogrammetric methods from photographs taken in December 1976 by Blevins Mapping Company (Reference 6). These data were furnished by Logan County in cooperation with the Colorado Water Conservation Board. Additional cross section data were furnished by the COE. U.S. Geological Survey 7.5-minute topographic quadrangle maps at a scale of 1:24,000, with a contour interval of 10 feet (Reference 7) were also used.

Bridge and roadway survey data were furnished by the Colorado Water Conservation Board.

Water-surface profiles for the floods studied in this report were developed using the COE HEC-2 step-backwater computer program (Reference 8). The computations were based on channel and floodplain conditions represented by survey data gathered in December 1976 and supplemented by later field investigations.

The detailed topographic maps that were used to assist in delineating the 100- and 500-year floodplain boundaries covering the South Platte River had a scale of 1:2,400 with a 2-foot contour interval (Reference 6), and maps covering a portion of the Pawnee Creek Overflow area southwest of Sterling had a scale of 1:1,200 with a contour interval of 2 feet. These maps were prepared in 1977 by Blevins Mapping Company, under contract with the Colorado Water Conservation Board, in cooperation with Logan County (Reference 9).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1) and also shown on the Flood Insurance Rate Map (Exhibit 2).

Channel roughness factors along the South Platte River ranged from 0.03 to 0.035. The starting water-surface elevation for the South Platte River was determined using normal-depth computations and 10-year contiguous peaks for Sand Creek and Pawnee Creek Overflow.

The hydraulic analyses for this study are based on unobstructed flow. The flood elevations shown on the profile are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum (NGVD) of 1929. Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study includes a floodplain boundary map designed to assist communities in developing sound floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section.

Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000, with a contour interval of 10 feet (Reference 7).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE) and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close-together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

The 100-year floodplain boundaries for the South Platte River, studied by approximate methods, were delineated using the previously referenced topographic maps (Reference 7).

Approximate 100-year floodplain boundaries in some portions of the study area were taken directly from the Flood Hazard Boundary Map for Logan County (Reference 10).

4.2 Floodways

The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Floodways were not computed for the reports used to prepare this study; therefore, no floodways have been included in this study.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance

Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains and the locations of selected cross sections used in the hydraulic analysis.

7.0 OTHER STUDIES

Flood Insurance Rate Maps have been published for the Towns of Iliff and Crook (References 11 and 12), and a Flood Insurance Study is being processed for the City of Sterling (Reference 13). Information shown on the maps and study are in exact agreement with this Flood Insurance Study.

A Flood Hazard Boundary Map has been published for Logan County (Reference 10). In some areas information shown on the Flood Hazard Boundary Map has been superseded due to the more detailed analyses performed for these areas.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Denver Federal Center, Building 710, Box 25267, Denver, Colorado 80225-0267.

9.0 BIBLIOGRAPHY AND REFERENCES

1. U.S. Department of the Army, Corps of Engineers, Omaha District, Special Flood Hazard Information Report, South Platte River, Volume III, prepared for Logan County, Sedgwick County, and the Colorado Water Conservation Board, June 1977.

2. U.S. Department of the Army, Corps of Engineers, Omaha District, Floodplain Information, South Platte River and Pawnee Creek, Sterling, Colorado, prepared for Logan County and Colorado Water Conservation Board, September 1978.

3. Charles F. Leaf, P.E. and Resource Consultants Inc., Summary Report, Floodplain Information, Sand Creek and the Pawnee Creek Overflow at Sterling, Colorado, prepared for City of Sterling and Colorado Water Conservation Board, January 1987.

4. U.S. Department of Commerce, Bureau of the Census, 1980 Census of Population, Number of Inhabitants, Colorado, 1981.

5. U.S. Department of Commerce, Weather Bureau, Technical Paper 40, Rainfall Frequency Atlas of the United States, 1961.

6. Blevins Mapping Company, Aerial Photographs, Logan County, Colorado, flown at scale of 1:2,400, December 1976.

7. U.S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Quadrangle Maps, Scale 1:24,000, Contour Interval 10 feet.

8. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles: Users Manual, Davis California, 1981.

9. Blevins Mapping Company, Topographic Maps, Logan County, Colorado, Scale 1:1,200, Contour Interval 2 feet, 1977.

10. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Maps, Logan County, Colorado (Unincorporated Areas), April 7, 1978.

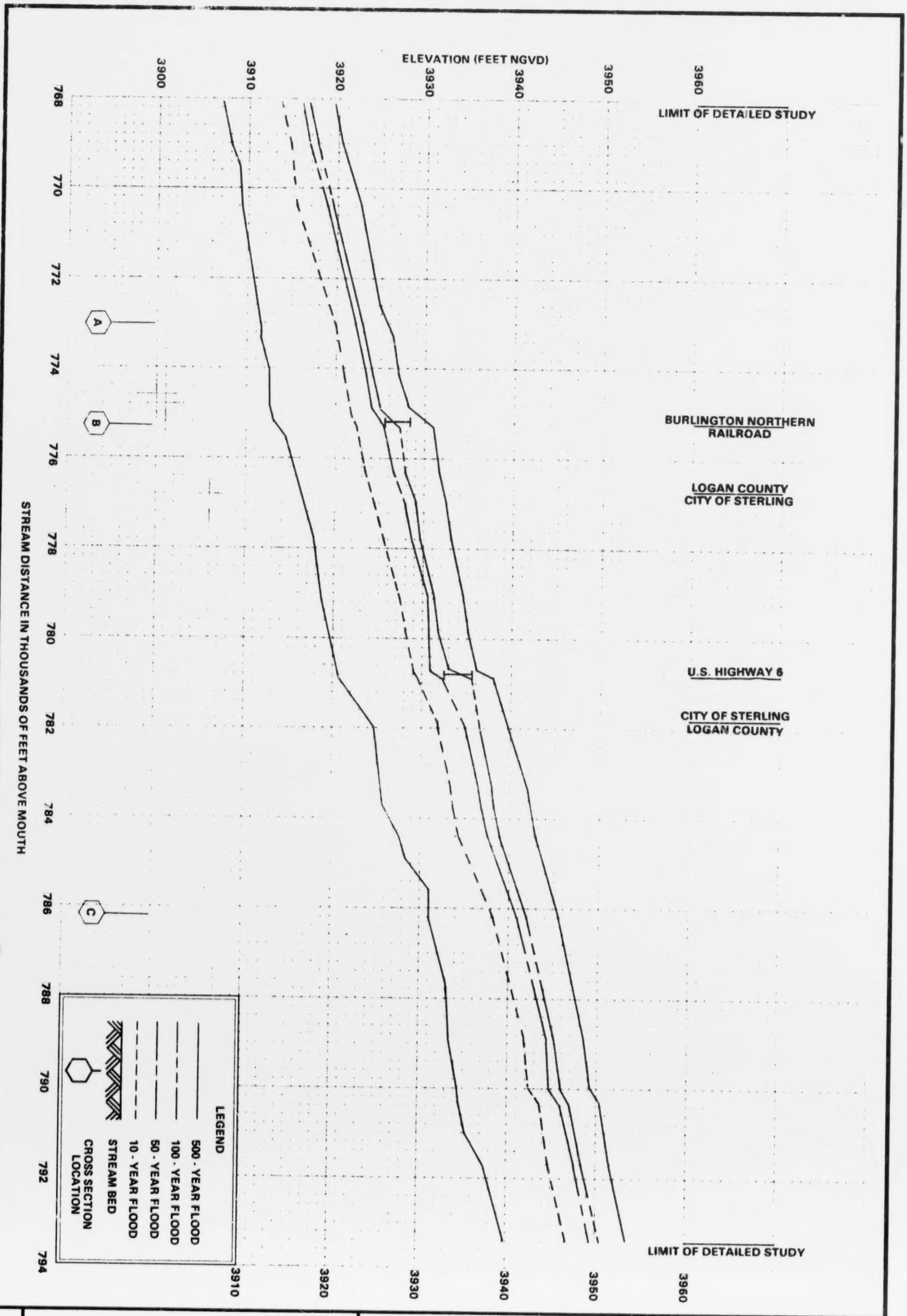
11. Federal Emergency Management Agency, Flood Insurance Rate Map, Town of Iliff, Colorado, August 4, 1987.

12. Federal Emergency Management Agency, Flood Insurance Rate Map, Town of Crook, Colorado, February 5, 1986.

13. Federal Emergency Management Agency, Flood Map, City of Sterling, Colorado, unpublished.

EXHIBIT 3. ELEVATION REFERENCE MARKS
LOGAN COUNTY, COLORADO (UNINCORPORATED AREAS)

Reference Marks	Elevation (Feet)	Description of Location
RM 1	3,924.61	A brass cap (No. 46) set in a 6-inch concrete post located on the north side of the intersection of Drain Ditch Road and North Division Avenue, 7.0 feet north of asphalt at west end of barricade.
RM 2	3,964.14	A brass cap (No. 55) set as a highway right-of-way marker located in the southeast quadrant of intersection of Highway 14 and Iris Drive.
RM 3	3,957.34	A brass cap (No. 35) set in a 6-inch concrete post located 700 feet south of the railroad tracks on the north side of Iris Drive, 10 feet north of the asphalt and 20 feet west of the driveway to Lindsey Grinding Service.



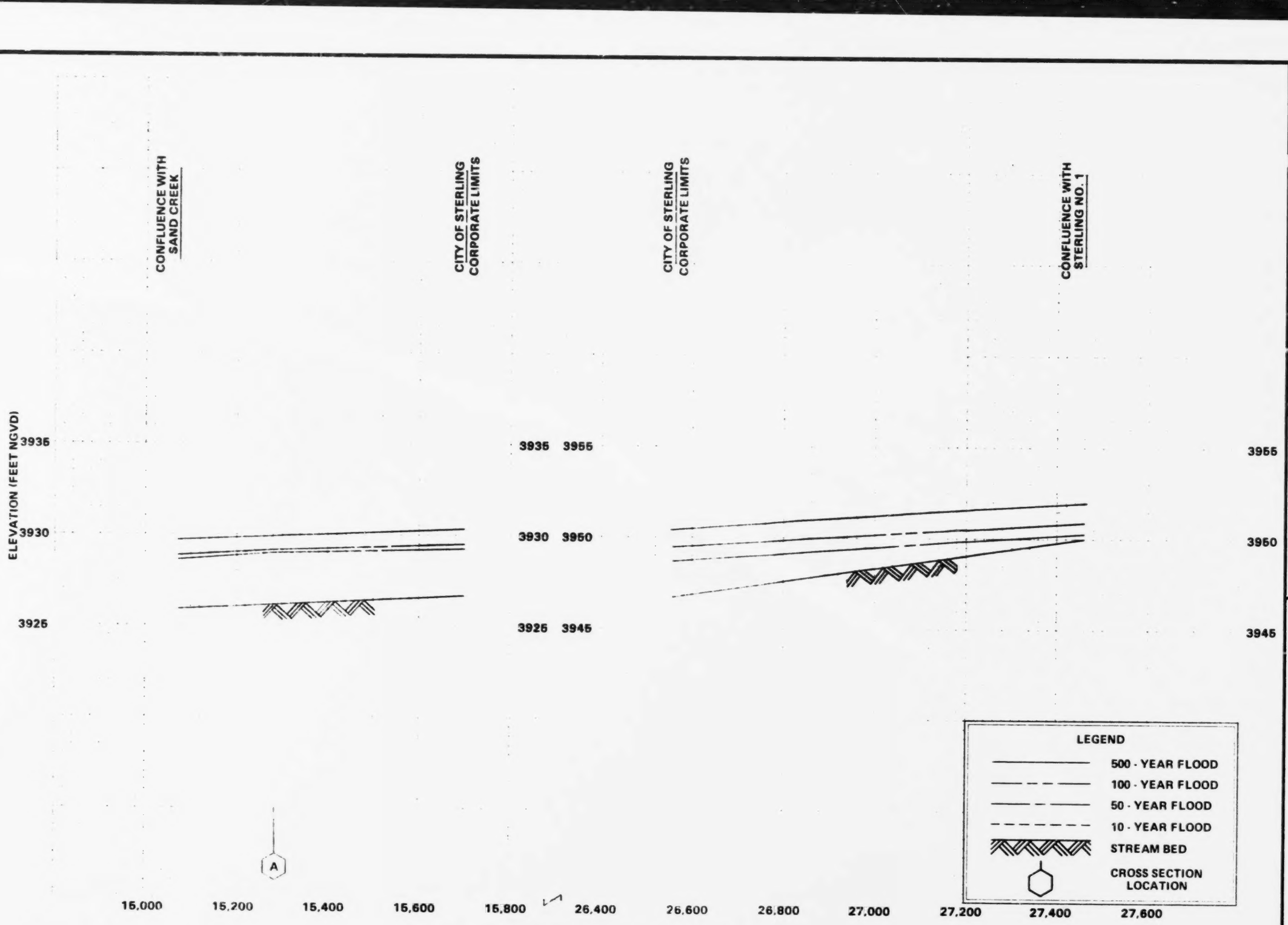
01P

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOGAN CO, CO
(UNINCORPORATED AREAS)

FLOOD PROFILES

SOUTH PLATTE RIVER



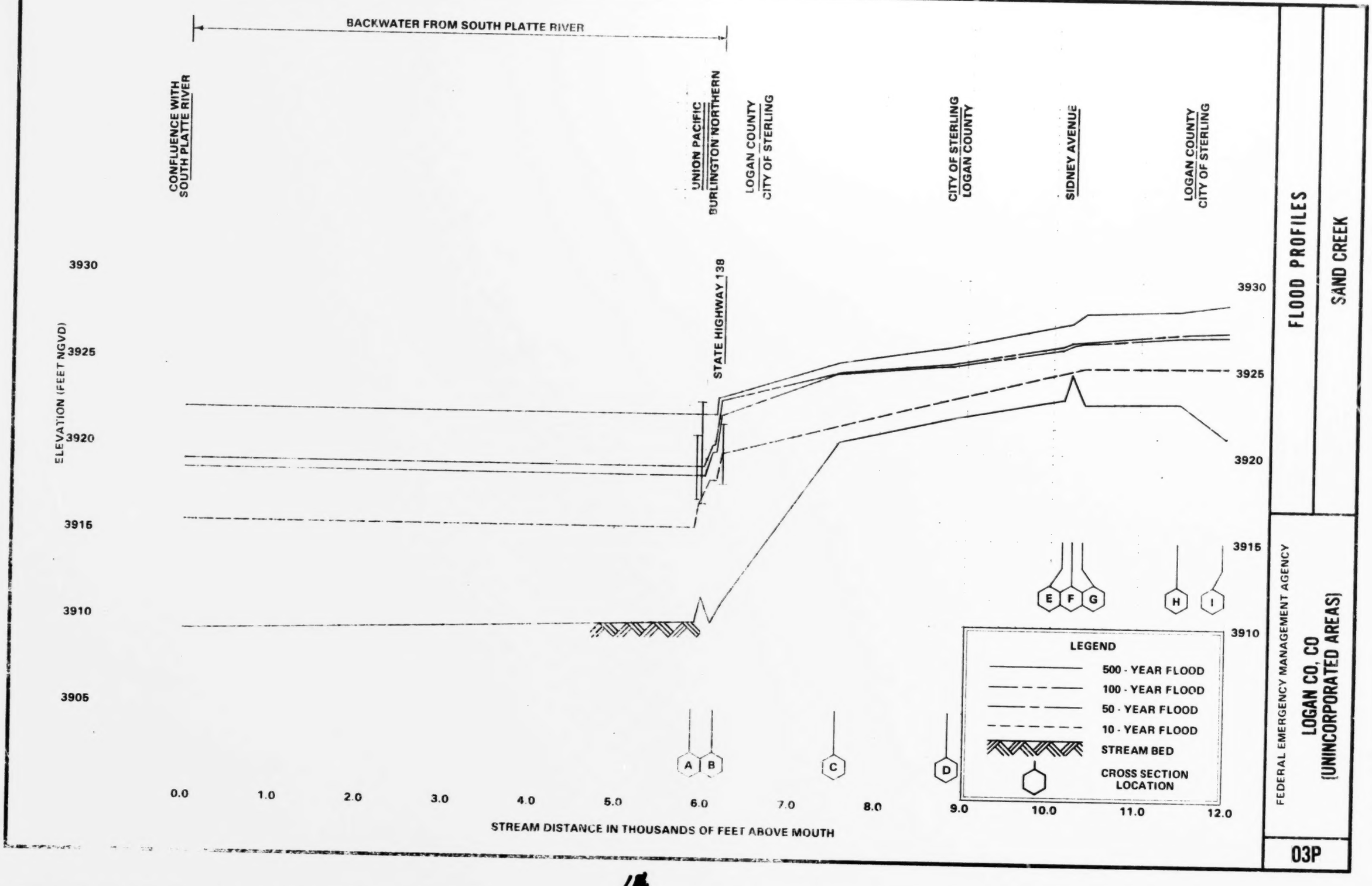
FLOOD PROFILES

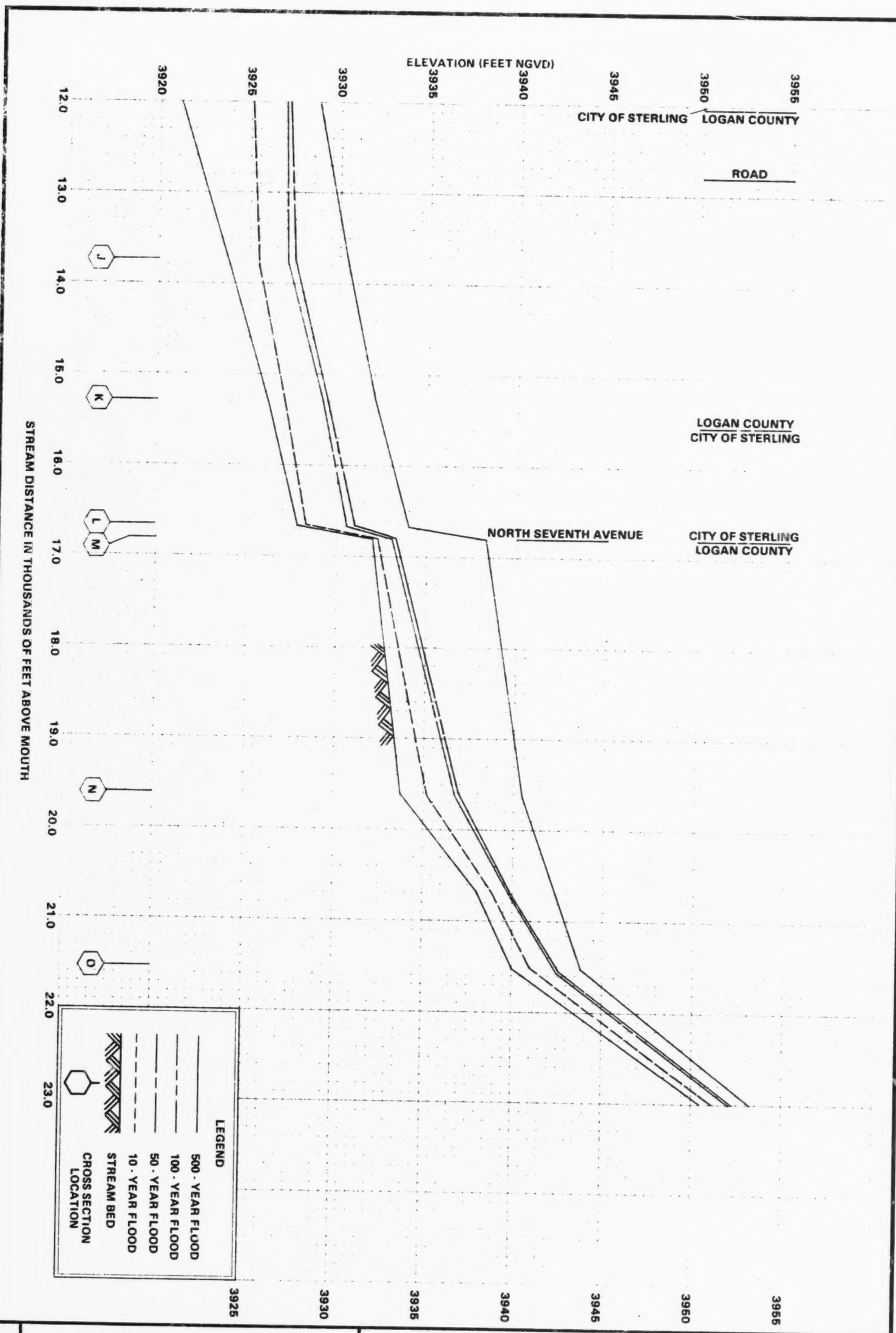
PAWNEE CREEK OVERFLOW

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOGAN CO, CO
(UNINCORPORATED AREAS)

02P


BACKWATER FROM SOUTH PLATTE RIVER
CONFLUENCE WITH SOUTH PLATTE RIVER
UNION PACIFIC BURLINGTON NORTHERN
LOGAN COUNTY CITY OF STERLING
CITY OF STERLING LOGAN COUNTY
SIDNEY AVENUE
LOGAN COUNTY CITY OF STERLING
STATE HIGHWAY 138
ELEVATION (FEET NGVD)
3930
3925
3920
3915
3910
3905
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
STREAM DISTANCE IN THOUSANDS OF FEET ABOVE MOUTH
A
B
C
D
E
F
G
H
I
LEGEND
500 - YEAR FLOOD
100 - YEAR FLOOD
50 - YEAR FLOOD
10 - YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION
FLOOD PROFILES
SAND CREEK
FEDERAL EMERGENCY MANAGEMENT AGENCY
LOGAN CO, CO
(UNINCORPORATED AREAS)
03P



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04P

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOGAN CO, CO
(UNINCORPORATED AREAS)

FLOOD PROFILES

SAND CREEK

FLOOD PROFILES

SAND CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LOGAN CO, CO
(UNINCORPORATED AREAS)

05P